PATENT ABSTRACTS OF JAPAN

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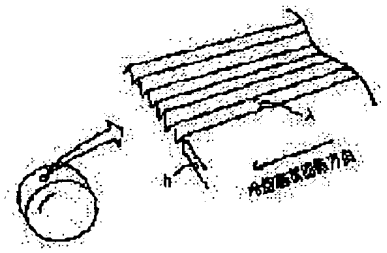
(54) QUENCHED THIN METALLIC STRIP AND PRODUCING APPARATUS THEREOF

(57)Abstract:
PURPOSE: To obtain a quenched thin metallic strip reduced in air pocket and excellent in magnetic characteristic and occupying vol. rate by periodically forming the specific shapes of recessed part and projecting part on the surface of a cooling base plate for quenching molten alloy.
CONSTITUTION: In a producing apparatus of the quenched thin metallic strip, on the surface of the cooling base plate in contact with the molten metal, the continuous recessed parts or projecting parts having ≥100 μm length in the rotating direction of the cooling base plate are formed alternately and periodically in the rotating axial direction. The molten metal is spouted on the cooling base plate to produce the quenched thin metallic strip. By this method, at least on one side surface of the thin metallic strip, the continuous recessed parts or projecting parts having a length of ≥100 μm in parallel to the longitudinal direction are formed. These recessed parts or projecting parts are alternately and periodically arranged to the width direction of the thin strip. Further, the range of the recessed parts and the projecting parts are made to occupy at least ≥70% on one side surface. Gas entrapped in the molten metal is exhausted through the grooves formed with the recessed parts or the projecting parts before solidifying the molten metal.



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CLAIMS

[Claim(s)]
[Claim 1] The quenching metal thin band characterized by the thing of a band-like thin band which it has the continuous crevice or continuous heights with a length of 100 micrometers or more in parallel to the longitudinal direction of a thin band, those crevices or heights are periodically arranged by turns to the cross direction of this thin band on the surface of one side at least, and the field of this concavo-convex section occupies 70% or more in the front face of one side at least.
[Claim 2] The quenching metal thin band according to claim 1 which has the continuous crevice or continuous heights with a length of 1mm or more in parallel to the longitudinal direction of a thin band.
[Claim 3] In the manufacturing installation of a quenching metal thin band which has equipment which grinds the cooling substrate which carries out high-speed rotation and this cooling substrate for cooling the equipment which fuses an alloy, and the melting alloy which spouts a melting alloy from a nozzle, and which equipment [the alloy] and blew off The quenching metal thin band manufacturing installation characterized by for the field in contact with the molten metal of a cooling substrate having one the continuous crevice or continuous heights with a length of 100 micrometers or more in the hand of cut of a cooling substrate, and arranging them periodically by turns to the direction of the axis of rotation.
[Claim 4] The quenching metal thin band manufacturing installation according to claim 3 whose average peak value h of the adjoining concavo-convex section the average period lambda of the concavo-convex section of the direction of the cooling substrate axis of rotation is 0< lambda<=500 micrometers, and is 0< h<=5 micrometers.
[Claim 5] A quenching metal thin band manufacturing installation given in the claims 3 and 4 which have one the continuous crevice or continuous heights with a length of 1mm or more in the hand of cut of a cooling substrate.
DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the metal thin band which blew off and carried out the rapid solidification of the alloy of a melting state to the cooling substrate which is carrying out high-speed rotation, and its manufacturing installation.
[0002]
[Description of the Prior Art] By quenching an alloy from a melting state, the centrifugal quenching method, the single rolling method, the congruence rolling method, etc. are learned as a method of manufacturing a thin band continuously. By making molten metal blow off from an orifice etc. to the inner skin or the periphery side of a metal drum which carries out high-speed rotation, these methods make molten metal solidify quickly, and manufacture a thin band and a wire rod. Furthermore, by choosing alloy composition proper, an amorphous alloy similar to a liquid metal can be obtained, and a material excellent in the magnetic property or the mechanical property can be manufactured.
[0003] These amorphous alloy thin bands contact a cooling substrate, and are solidified by rapid **** by it. Therefore, the shape of surface type of a thin band is greatly influenced in the shape of [of a cooling substrate] surface type, and when magnetic properties not only deteriorate, but the shape of surface type of this thin band became coarse and it is made a coil or a layered product as core material, such as a transformer, the problem of a space factor falling produces it. Then, the technique of improving the shape of surface type of a thin band by specifying roll surface roughness from the former is developed.
[0004] For example, the cooling object which the front face made the irregularity below micron order by buffing (JP,62-166059,A), How to make a cooling roller front face the granularity ground and obtained with the abrasive paper of the abrasive-grain number of No. 600-1000 (JP,4-288952,A), The cooling object which made the contact surface the crepe side (JP,56-117868,A), The thin band manufactured by the cooling object and it which have a scratch in a cooling roller front face aslant to a hand of cut (JP,60-72648,A), There is a thin band (JP,58-14917,A) with which the direction of the slot of the concavo-convex section in a roll front face was manufactured with equipment parallel to the direction of roll axis and its equipment.
[0005] However, the comparatively big crevice of the shape of an island usually produced by the entrainment of the gas called air pocket in addition to the irregularity on the front face of a roll exists in the roll side side of the quenching thin band manufactured by the single rolling method etc. A space factor reduces this air pocket it not only degrades magnetic properties, but, and the publication about this air pocket does not have all in the above-mentioned well-known example. It seems that furthermore, it is a convention of only the granularity of the concavo-convex section, and an air pocket cannot be reduced about a convention of the relative roughness of a thin band surface girdle cooling body surface.
[0006] Moreover, in JP,62-166059,A and JP,4-288952,A, since the surface roughness of the cooling object specified using abrasive-grain abrasive paper etc. is made, the slot of the concavo-convex section of a cooling body surface will not have resulted in the hand of cut of a cooling object once, by the time ********** can reduce an air pocket. In JP,56-117868,A, JP,60-72648,A, and JP,58-14917,A, the slot of the concavo-convex section of a cooling body surface inclines to the hand of cut of a cooling object, or has a right angle.

[0007]
[Problem(s) to be Solved by the Invention] Although the improvement in a property of a thin band was tried by specifying the shape of surface type of a cooling object as shown above, the manufacturing installation which can suppress that an air pocket is made in the field in contact with the cooling object of a thin band, and the quenching metal thin band manufactured by it were not in the former.
[0008] this invention aims at offering the quenching metal thin band excellent in the magnetic properties and the space factor which the air pocket reduced, and its manufacturing installation by improving the shape of surface type of a cooling object.
[0009]
[Means for Solving the Problem] this invention makes the following matter the summary.
(1) The quenching metal thin band characterized by the thing of a band-like thin band which it has the continuous crevice or continuous heights with a length of 100 micrometers or more in parallel to the longitudinal direction of a thin band, those crevices and heights are periodically arranged by turns to the cross direction of this thin band on the surface of one side at least, and the field of this concavo-convex section occupies 70% or more in the front face of one side at least.
(2) A quenching metal thin band given in the preceding clause (1) which has the continuous crevice or continuous heights with a length of 1mm or more in parallel to the longitudinal direction of a thin band.
(3) In the manufacturing installation of a quenching metal thin band which has equipment which grinds the cooling substrate which carries out high-speed rotation and this cooling substrate for cooling a melting alloy the bottom the equipment which fuses an alloy, the equipment which spouts a melting alloy from a nozzle, and jet -- The quenching metal thin band manufacturing installation characterized by for the field which touches the molten metal of a cooling substrate having one the continuous crevice or continuous heights with a length of 100 micrometers or more in the hand of cut of a cooling substrate, and arranging them periodically by turns to the direction of the axis of rotation.
(4) A quenching metal thin band manufacturing installation given in the preceding clause (3) whose average peak value h of the adjoining concavo-convex section the average period lambda of the concavo-convex section of the direction of the cooling substrate axis of rotation is 0< lambda<=500 micrometers, and is 0< h<=5 micrometers.
(5) The preceding clause (3) which has one the continuous crevice or continuous heights with a length of 1mm or more in the hand of cut of a cooling substrate, and a quenching metal thin band manufacturing installation given in (4).
[0010] Below, this invention is explained in detail. The cross-section enlarged view of the cooling substrate front face at the time of grinding with the usual abrasive-grain abrasive paper as a conventional example was shown in drawing 1 . The portion with which only orderly predetermined length is located in a line has a crevice or slight heights, a crevice or heights cross mutually, they are crossing swords, and almost all portions will be gone out on the way by the slot so that drawing 1 may show. Since the slot has run out on the way, it will become impossible therefore, to move it, although the gas involved in between the cooling substrate and the molten metal from the upstream of a paddle during casting is put back to an upstream by the pressure of a molten metal. Therefore, it solidifies, where a part of gas is involved in, and it appears in a thin band as an air pocket. Although this air pocket is based also on casting conditions, it is large and reaches **** of 20 micrometers, and a length of about 200 micrometers.
[0011] This invention persons found out that generating of an air pocket could be reduced by newly specifying the length of the cooling substrate hand of cut of not only the relative roughness of the cooling substrate adopted conventionally but a crevice or heights, as a result of repeating various examination.
[0012] The cross-section enlarged view of the front face which is an example of the cooling substrate by this invention is shown in drawing 2 . It had one the continuous crevice or continuous heights with a length of 100 micrometers or more in the hand of cut of a cooling substrate, and they arrange periodically by turns to the direction of the axis of rotation. Although drawing 2 showed the case where a concavo-convex cross section was triangular-wave-like, it suits and the sine wave configuration of others [**], such as a square wave target, is also included in this invention range. That is, before a molten metal solidifies through the slot where the gas involved in at once by preparing the field which has arranged periodically by turns the crevice or heights whose length of the hand of cut of a cooling substrate is 100 micrometers or more in the direction of the axis of rotation is tidily located in a line with a length of 100 micrometers or more, as a result of extruding, it is thought that an air pocket decreases.
[0013] For reducing an air pocket further, the length of the cooling substrate hand of cut of a crevice or heights is set to 1mm or more. When the ease of processing is taken into consideration, it is desirable to set this length to 5mm or more. By preparing such a field over the perimeter of a cooling substrate, the thin band which the air pocket reduced over the overall length is obtained.
[0014] The average period lambda of the concavo-convex section of a cooling substrate or the configuration of a thin band front face where the adjoining average peak value h was cooled is influenced. lambda= 0 and h= 0 were in the mirror-plane state, and in this state, the wettability of a cooling substrate and a molten metal was not able to become bad, and they were not able to obtain a healthy thin band. In lambda> 500 micrometers, the effect that the gas involved in since the number of slots decreased is extruded decreases. Moreover, in h> 5

micrometers, although an air pocket is suppressed, the irregularity of the cooled thin band will become large and the shape of surface type will become bad. Therefore, it limited to 0< lambda<=500 micrometers and 0< h<=5 micrometers.

[0015] The cooling substrate front face of this invention can be easily formed using tool steel, such as super-steel into which the predetermined configuration was processed, using the abrasive paper which put the abrasive grain in order regularly. As the quality of the material to be used, if a degree of hardness is larger than not only super-steel but a cooling substrate, it is usable. Moreover, it is also possible to maintain a predetermined surface state, grinding on-line, as shown in drawing 3 . However, drawing 3 is the schematic diagram of a quenching thin band manufacturing installation, and consists of equipment which grinds the cooling substrate for cooling the equipment which fuses an alloy, and the melting alloy which spouts a melting alloy from a nozzle, and which equipment [the alloy] and blew off which carries out high-speed rotation, and a cooling substrate.

[0016] The air pocket is reduced, even if there are few band-like thin bands, the continuous crevice or continuous heights with a length of 100 micrometers or more arranges periodically in parallel the thin band cooled by the above-mentioned manufacturing installation by turns to the cross direction of this thin band on the front face by the side of a cooling substrate to the longitudinal direction of a thin band, and this concavo-convex section comes to occupy it 70% or more in the front face of one side at least. If it says and changes, an air pocket will become less than 30% in the front face of one side at least. If it sees from the point of a space factor, it is desirable that this concavo-convex section comes to occupy 80% or more in the front face of one side at least. Furthermore, by setting the hand-of-cut length of the crevice of a cooling substrate, or heights to 1mm or more, an air pocket decreases further and a thin band with the continuous crevice or continuous heights with a length of 1mm or more is obtained in parallel to the longitudinal direction of a thin band.

[0017] The period of the concavo-convex section of the cooling substrate side front face of the thin band cooled by the cooling substrate of this invention is usually set to 500 micrometers or less in response to the influence of the concavo-convex section of a substrate, and the average peak value of the adjoining concavo-convex section is set to 5 micrometers or less. The board thickness of a thin band can be manufactured to what exceeds 10-100 micrometers using a well-known single slit nozzle or a multiplex slit nozzle. When board thickness is thin, the irregularity of a cooling substrate also influences the free-surface side (the field which touches a cooling substrate, and field of an opposite side) of a thin band, and the irregularity according to the irregularity of a cooling substrate appears. In manufacturing a thick thin band using a multiplex slit nozzle, the irregularity of a cooling substrate is in the inclination to be hard coming to influence the free-surface side of a thin band.

[0018]

[Example] Hereafter, this invention is further explained based on an example.

The alloy of example 1Fe80.5Si 6.5B12C1 (at%) is dissolved, and it is 700rpm from a double slot nozzle (width-of-face =0.4mm, length =25mm, interval =1mm). The molten metal was injected after the revolving roll made from Cu with a diameter of 580mm, and the quenching thin band with a width of face [of 25mm] and a thickness of 60 micrometers was produced.

[0019] Under the present circumstances, Cu roll front face was processed into irregularity predetermined by the following method. That is, a mirror plane is first made to a roll front face by the polish and buffing by the usual emery paper. Next, pressing a fixture against tool steel using the fixture which attached irregularity beforehand, the roll was rotated and the irregularity of a predetermined size was attached to the roll front face. The length which is following the hand of cut of the concavo-convex section was adjusted by changing rotation distance at that time. The cross-section configuration of the concavo-convex direction of roll axis became a triangular-wave-thing as a result, and the average peak value of the concavo-convex section which about 40 micrometers of average periods of the concavo-convex section adjoin was set to about 0.8 micrometers.

[0020] Measurement of the concavo-convex section on the front face of a roll imprinted the irregularity of a roll to the resin by the replica method, and was performed by measuring the resin with a relative roughness plan. The rate of the air pocket of the roll ******** front face for which it asked from the photograph taken with the evaluation and the optical microscope by the relative roughness meter estimated the shape of surface type of a thin band. All portions other than the air pocket of a thin band front face have the concavo-convex section which followed the thin band longitudinal direction of the almost same length as the length of the concavo-convex section on the front face of a roll, and they arranged them periodically by turns to the cross direction. The measurement result is shown in Table 1.

[0021]

[Table 1]

表　1

試料No.		凹凸部のロール回転方向長さ（連続している部分の長さ）	薄帯表面のｴｱｰﾎﾟｹｯﾄ 率(%)（ロール面側）
比較例	1	30μm	35
	2	70μm	33
本発明例	3	120μm	26
	4	450μm	25
	5	730μm	23
	6	1．2mm	18
	7	3．0mm	16
	8	20mm	13
	9	100mm	13
	10	ロール周囲の1/2 長さ	11
	11	ロール全周長さ	12

[0022] As shown in Table 1, according to this invention, it becomes possible by setting the length of the roll hand of cut of the concavo-convex section to 100 micrometers or more to obtain the thin band which suppressed the rate of an air pocket lower than 30%. Furthermore, the thin band which suppressed the rate of an air pocket to 20% or less can be obtained by setting the length to 1mm or more.
[0023] The irregularity shown in Table 2 was processed into the roll front face using the fixture which attached the irregularity of an example 2 various size. It carried out like the example 1 except having fixed length which followed the concavo-convex roll hand of cut with the 1 / the 2 length of the circumference of a roll. However, lambda is the average period of the concavo-convex section, and the average peak value of the concavo-convex section which h adjoins. All portions other than the air pocket of a thin band front face have the concavo-convex section which followed the thin band longitudinal direction of the almost same length as the length of the concavo-convex section on the front face of a roll, and they arranged them periodically by turns to the cross direction. The result is written together to Table 2.
[0024]
[Table 2]

表　2

試料No.	凹凸部の平均周期 λ（μm）	隣接する凹凸部の平均波高値 h（μm）	薄帯表面のｴｱｰﾎﾟｹｯﾄ 率(%)（ロール面側）
12（比較例）	0	0	不良薄帯となった
13（本発明例）	12	0．8	13
14 〃	40	0．9	11
15 〃	105	0．9	14
16 〃	255	1．2	16
17 〃	360	1．5	21
18 〃	480	1．4	24
19（比較例）	580	1．3	32
20 〃	720	1．2	34
21（本発明例）	35	1．3	12
22 〃	50	2．5	15
23 〃	68	3．8	21
24（比較例）	72	5．2	23（表面凹凸大）
25 〃	82	6．5	27（表面凹凸大）

[0025] As shown in Table 2, according to this invention, the thin band which suppressed the rate of an air pocket lower than 30% can be manufactured by making it 0< lambda<=500 micrometers and 0< h<=5

micrometers. However, although the rate of an air pocket was lower than 30% by 25 as sample No.24 of Table 2, since surface irregularity became large and the shape of surface type became bad, it was presupposed that this invention is out of range.

[0026]

[Effect of the Invention] By manufacturing a thin band using the cooling substrate which specified the shape of surface type according to this invention, the relative roughness of a thin band front face can be improved, and the thin band which reduced generating of an air pocket can be obtained. Thus, a space factor not only improves but magnetic properties are improved when the obtained thin band is used as a volume core or a laminating core as a use of a transformer etc.

TECHNICAL FIELD

[Industrial Application] this invention relates to the metal thin band which blew off and carried out the rapid solidification of the alloy of a melting state to the cooling substrate which is carrying out high-speed rotation, and its manufacturing installation.

PRIOR ART

[Description of the Prior Art] By quenching an alloy from a melting state, the centrifugal quenching method, the single rolling method, the congruence rolling method, etc. are learned as a method of manufacturing a thin band continuously. By making molten metal blow off from an orifice etc. to the inner skin or the periphery side of a metal drum which carries out high-speed rotation, these methods make molten metal solidify quickly, and manufacture a thin band and a wire rod. Furthermore, by choosing alloy composition proper, an amorphous alloy similar to a liquid metal can be obtained, and a material excellent in the magnetic property or the mechanical property can be manufactured.

[0003] These amorphous alloy thin bands contact a cooling substrate, and are solidified by rapid **** by it. Therefore, the shape of surface type of a thin band is greatly influenced in the shape of [of a cooling substrate] surface type, and when magnetic properties not only deteriorate, but the shape of surface type of this thin band became coarse and it is made a coil or a layered product as core material, such as a transformer, the problem of a space factor falling produces it. Then, the technique of improving the shape of surface type of a thin band by specifying roll surface roughness from the former is developed.

[0004] For example, the cooling object which the front face made the irregularity below micron order by buffing (JP,62-166059,A), How to make a cooling roller front face the granularity ground and obtained with the abrasive paper of the abrasive-grain number of No. 600-1000 (JP,4-288952,A), The cooling object which made the contact surface the crepe side (JP,56-117868,A), The thin band manufactured by the cooling object and it which have a scratch in a cooling roller front face aslant to a hand of cut (JP,60-72648,A), There is a thin band (JP,58-14917,A) with which the direction of the slot of the concavo-convex section in a roll front face was manufactured with equipment parallel to the direction of roll axis and its equipment.

[0005] However, the comparatively big crevice of the shape of an island usually produced by the entrainment of the gas called air pocket in addition to the irregularity on the front face of a roll exists in the roll side side of the quenching thin band manufactured by the single rolling method etc. A space factor reduces this air pocket it not only degrades magnetic properties, but, and the publication about this air pocket does not have all in the above-mentioned well-known example. It seems that furthermore, it is a convention of only the granularity of the concavo-convex section, and an air pocket cannot be reduced about a convention of the relative roughness of a thin band surface girdle cooling body surface.

[0006] Moreover, in JP,62-166059,A and JP,4-288952,A, since the surface roughness of the cooling object specified using abrasive-grain abrasive paper etc. is made, the slot of the concavo-convex section of a cooling body surface will not have resulted in the hand of cut of a cooling object once, by the time ********** can reduce an air pocket. In JP,56-117868,A, JP,60-72648,A, and JP,58-14917,A, the slot of the concavo-convex section of a cooling body surface inclines to the hand of cut of a cooling object, or has a right angle.

EFFECT OF THE INVENTION

[Effect of the Invention] By manufacturing a thin band using the cooling substrate which specified the shape of surface type according to this invention, the relative roughness of a thin band front face can be improved, and the thin band which reduced generating of an air pocket can be obtained. Thus, a space factor not only improves but magnetic properties are improved when the obtained thin band is used as a volume core or a laminating core as a use of a transformer etc.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Although the improvement in a property of a thin band was tried by specifying the shape of surface type of a cooling object as shown above, the manufacturing installation which can suppress that an air pocket is made in the field in contact with the cooling object of a thin band, and the quenching metal thin band manufactured by it were not in the former.

[0008] this invention aims at offering the quenching metal thin band excellent in the magnetic properties and the space factor which the air pocket reduced, and its manufacturing installation by improving the shape of surface type of a cooling object.

MEANS

[Means for Solving the Problem] this invention makes the following matter the summary.

(1) The quenching metal thin band characterized by the thing of a band-like thin band which it has the continuous crevice or continuous heights with a length of 100 micrometers or more in parallel to the longitudinal direction of a thin band, those crevices and heights are periodically arranged by turns to the cross direction of this thin band on the surface of one side at least, and the field of this concavo-convex section occupies 70% or more in the front face of one side at least.

(2) A quenching metal thin band given in the preceding clause (1) which has the continuous crevice or continuous heights with a length of 1mm or more in parallel to the longitudinal direction of a thin band.

(3) In the manufacturing installation of a quenching metal thin band which has equipment which grinds the cooling substrate which carries out high-speed rotation and this cooling substrate for cooling a melting alloy the bottom the equipment which fuses an alloy, the equipment which spouts a melting alloy from a nozzle, and jet -- The quenching metal thin band manufacturing installation characterized by for the field which touches the molten metal of a cooling substrate having one the continuous crevice or continuous heights with a length of 100 micrometers or more in the hand of cut of a cooling substrate, and arranging them periodically by turns to the direction of the axis of rotation.

(4) A quenching metal thin band manufacturing installation given in the preceding clause (3) whose average peak value h of the adjoining concavo-convex section the average period lambda of the concavo-convex section of the direction of the cooling substrate axis of rotation is 0< lambda<=500 micrometers, and is 0< h<=5 micrometers.

(5) The preceding clause (3) which has one the continuous crevice or continuous heights with a length of 1mm or more in the hand of cut of a cooling substrate, and a quenching metal thin band manufacturing installation given in (4).

[0010] Below, this invention is explained in detail. The cross-section enlarged view of the cooling substrate front face at the time of grinding with the usual abrasive-grain abrasive paper as a conventional example was shown in drawing 1 . The portion with which only orderly predetermined length is located in a line has a crevice or slight heights, a crevice or heights cross mutually, they are crossing swords, and almost all portions will be gone out on the way by the slot so that drawing 1 may show. Since the slot has run out on the way, it will become impossible therefore, to move it, although the gas involved in between the cooling substrate and the molten metal from the upstream of a paddle during casting is put back to an upstream by the pressure of a molten metal. Therefore, it solidifies, where a part of gas is involved in, and it appears in a thin band as an air pocket. Although this air pocket is based also on casting conditions, it is large and reaches **** of 20 micrometers, and a length of about 200 micrometers.

[0011] This invention persons found out that generating of an air pocket could be reduced by newly specifying the length of the cooling substrate hand of cut of not only the relative roughness of the cooling substrate adopted conventionally but a crevice or heights, as a result of repeating various examination.

[0012] The cross-section enlarged view of the front face which is an example of the cooling substrate by this invention is shown in drawing 2 . It had one the continuous crevice or continuous heights with a length of 100 micrometers or more in the hand of cut of a cooling substrate, and they arrange periodically by turns to the direction of the axis of rotation. Although drawing 2 showed the case where a concavo-convex cross section was triangular-wave-like, it suits and the sine wave configuration of others [**], such as a square wave target, is also included in this invention range. That is, before a molten metal solidifies through the slot where the gas involved in at once by preparing the field which has arranged periodically by turns the crevice or heights whose length of the hand of cut of a cooling substrate is 100 micrometers or more in the direction of the axis of rotation is tidily located in a line with a length of 100 micrometers or more, as a result of extruding, it is thought that an air pocket decreases.

[0013] For reducing an air pocket further, the length of the cooling substrate hand of cut of a crevice or heights is set to 1mm or more. When the ease of processing is taken into consideration, it is desirable to set this length to 5mm or more. By preparing such a field over the perimeter of a cooling substrate, the thin band which the air pocket reduced over the overall length is obtained.

[0014] The average period lambda of the concavo-convex section of a cooling substrate or the configuration of a thin band front face where the adjoining average peak value h was cooled is influenced. lambda= 0 and h= 0 were in the mirror-plane state, and in this state, the wettability of a cooling substrate and a molten metal was not able to become bad, and they were not able to obtain a healthy thin band. In lambda> 500 micrometers, the

effect that the gas involved in since the number of slots decreased is extruded decreases. Moreover, in h> 5 micrometers, although an air pocket is suppressed, the irregularity of the cooled thin band will become large and the shape of surface type will become bad. Therefore, it limited to 0< lambda<=500 micrometers and 0< h<=5 micrometers.

[0015] The cooling substrate front face of this invention can be easily formed using tool steel, such as super-steel into which the predetermined configuration was processed, using the abrasive paper which put the abrasive grain in order regularly. As the quality of the material to be used, if a degree of hardness is larger than not only super-steel but a cooling substrate, it is usable. Moreover, it is also possible to maintain a predetermined surface state, grinding on-line, as shown in drawing 3 . However, drawing 3 is the schematic diagram of a quenching thin band manufacturing installation, and consists of equipment which grinds the cooling substrate for cooling the equipment which fuses an alloy, and the melting alloy which spouts a melting alloy from a nozzle, and which equipment [the alloy] and blew off which carries out high-speed rotation, and a cooling substrate.

[0016] The air pocket is reduced, even if there are few band-like thin bands, the continuous crevice or continuous heights with a length of 100 micrometers or more arranges periodically in parallel the thin band cooled by the above-mentioned manufacturing installation by turns to the cross direction of this thin band on the front face by the side of a cooling substrate to the longitudinal direction of a thin band, and this concavo-convex section comes to occupy it 70% or more in the front face of one side at least. If it says and changes, an air pocket will become less than 30% in the front face of one side at least. If it sees from the point of a space factor, it is desirable that this concavo-convex section comes to occupy 80% or more in the front face of one side at least. Furthermore, by setting the hand-of-cut length of the crevice of a cooling substrate, or heights to 1mm or more, an air pocket decreases further and a thin band with the continuous crevice or continuous heights with a length of 1mm or more is obtained in parallel to the longitudinal direction of a thin band.

[0017] The period of the concavo-convex section of the cooling substrate side front face of the thin band cooled by the cooling substrate of this invention is usually set to 500 micrometers or less in response to the influence of the concavo-convex section of a substrate, and the average peak value of the adjoining concavo-convex section is set to 5 micrometers or less. The board thickness of a thin band can be manufactured to what exceeds 10-100 micrometers using a well-known single slit nozzle or a multiplex slit nozzle. When board thickness is thin, the irregularity of a cooling substrate also influences the free-surface side (the field which touches a cooling substrate, and field of an opposite side) of a thin band, and the irregularity according to the irregularity of a cooling substrate appears. In manufacturing a thick thin band using a multiplex slit nozzle, the irregularity of a cooling substrate is in the inclination to be hard coming to influence the free-surface side of a thin band.

EXAMPLE

[Example] Hereafter, this invention is further explained based on an example.

The alloy of example 1Fe80.5Si 6.5B12C1 (at%) is dissolved, and it is 700rpm from a double slot nozzle (width-of-face =0.4mm, length =25mm, interval =1mm). The molten metal was injected after the revolving roll made from Cu with a diameter of 580mm, and the quenching thin band with a width of face [of 25mm] and a thickness of 60 micrometers was produced.

[0019] Under the present circumstances, Cu roll front face was processed into irregularity predetermined by the following method. That is, a mirror plane is first made to a roll front face by the polish and buffing by the usual emery paper. Next, pressing a fixture against tool steel using the fixture which attached irregularity beforehand, the roll was rotated and the irregularity of a predetermined size was attached to the roll front face. The length which is following the hand of cut of the concavo-convex section was adjusted by changing rotation distance at that time. The cross-section configuration of the concavo-convex direction of roll axis became a triangular-wave-thing as a result, and the average peak value of the concavo-convex section which about 40 micrometers of average periods of the concavo-convex section adjoin was set to about 0.8 micrometers.

[0020] Measurement of the concavo-convex section on the front face of a roll imprinted the irregularity of a roll to the resin by the replica method, and was performed by measuring the resin with a relative roughness plan. The rate of the air pocket of the roll ******** front face for which it asked from the photograph taken with the evaluation and the optical microscope by the relative roughness meter estimated the shape of surface type of a thin band. All portions other than the air pocket of a thin band front face have the concavo-convex section which followed the thin band longitudinal direction of the almost same length as the length of the concavo-convex section on the front face of a roll, and they arranged them periodically by turns to the cross direction. The measurement result is shown in Table 1.

[0021]

[Table 1]

表　1

試料No.		凹凸部のロール回転方向長さ（連続している部分の長さ）	薄帯表面のｴｱｰﾎﾟｹｯﾄ 率(%)（ロール面側）
比較例	1	30μm	35
	2	70μm	33
本発明例	3	120μm	26
	4	450μm	25
	5	730μm	23
	6	1．2mm	18
	7	3．0mm	16
	8	20mm	13
	9	100mm	13
	10	ロール周囲の1/2 長さ	11
	11	ロール全周長さ	12

[0022] As shown in Table 1, according to this invention, it becomes possible by setting the length of the roll hand of cut of the concavo-convex section to 100 micrometers or more to obtain the thin band which suppressed the rate of an air pocket lower than 30%. Furthermore, the thin band which suppressed the rate of an air pocket to 20% or less can be obtained by setting the length to 1mm or more.
[0023] The irregularity shown in Table 2 was processed into the roll front face using the fixture which attached the irregularity of an example 2 various size. It carried out like the example 1 except having fixed length which followed the concavo-convex roll hand of cut with the 1 / the 2 length of the circumference of a roll. However, lambda is the average period of the concavo-convex section, and the average peak value of the concavo-convex section which h adjoins. All portions other than the air pocket of a thin band front face have the concavo-convex section which followed the thin band longitudinal direction of the almost same length as the length of the concavo-convex section on the front face of a roll, and they arranged them periodically by turns to the cross direction. The result is written together to Table 2.
[0024]
[Table 2]

表　2

試料No.	凹凸部の平均周期 λ（μm）	隣接する凹凸部の平均波高値 h（μm）	薄帯表面のｴｱｰﾎﾟｹｯﾄ 率(%)（ロール面側）
12（比較例）	0	0	不良薄帯となった
13（本発明例）	12	0．8	13
14 〃	40	0．9	11
15 〃	105	0．9	14
16 〃	255	1．2	16
17 〃	360	1．5	21
18 〃	480	1．4	24
19（比較例）	580	1．3	32
20 〃	720	1．2	34
21（本発明例）	35	1．3	12
22 〃	50	2．5	15
23 〃	68	3．8	21
24（比較例）	72	5．2	23（表面凹凸大）
25 〃	82	6．5	27（表面凹凸大）

[0025] As shown in Table 2, according to this invention, the thin band which suppressed the rate of an air pocket lower than 30% can be manufactured by making it 0< lambda<=500 micrometers and 0< h<=5

micrometers. However, although the rate of an air pocket was lower than 30% by 25 as sample No.24 of Table 2, since surface irregularity became large and the shape of surface type became bad, it was presupposed that this invention is out of range.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the cross-section enlarged view having shown the configuration of the front face which is an example of the conventional cooling substrate.
[Drawing 2] It is the cross-section enlarged view having shown the configuration of the front face which is an example of the cooling substrate by this invention.
[Drawing 3] It is the schematic diagram of a quenching thin band manufacturing installation.
[Description of Notations]
lambda Average period of the concavo-convex section
h Average peak value of the adjoining concavo-convex section
1 High Frequency Coil
2 Nozzle
3 Molten Metal
4 Thin Band
5 Cooling Roller
6 Burnisher

CORRECTION or AMENDMENT

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[Document to be Amended] Specification.
[Item(s) to be Amended] 0005.
[Method of Amendment] Change.
[Proposed Amendment]
[0005] However, the comparatively big crevice of the shape of an island usually produced by the entrainment of the gas called air pocket in addition to the irregularity on the front face of a roll exists in the roll side side of the quenching thin band manufactured by the single rolling method etc. A space factor reduces this air pocket it not only degrades magnetic properties, but, and the publication about this air pocket does not have all in the above-mentioned well-known example. It seems that furthermore, it is a convention of only the granularity of the concavo-convex section, and an air pocket cannot be reduced about a convention of the relative roughness of a thin band front face and a cooling body surface.

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	３７０			３７０Ｚ	

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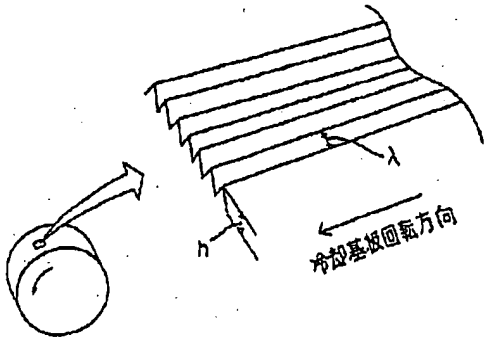
(54)【発明の名称】　急冷金属薄帯およびその製造装置

(57)【要約】

【目的】　冷却体の表面形状を改善することによって、エアーポケットの低減した磁気特性および占積率に優れた急冷金属薄帯、およびその製造装置を提供する。

【構成】　①帯状薄帯の少なくとも片側の表面に、薄帯の長手方向に対して平行に長さ１００μｍ以上の連続した凹部あるいは凸部を有し、凹部と凸部が該薄帯の幅方向に対して交互に周期的に配置され、凹凸部の領域が少なくとも片側の表面において７０％以上占めており、さらに薄帯の長手方向に対して平行に長さ１mm以上の連続した凹部あるいは凸部を有している急冷金属薄帯。②これらの薄帯を製造するための高速回転する冷却基板が、冷却基板の回転方向に長さ１００μｍ以上の一本の連続した凹部あるいは凸部を有し、かつ、それらが回転軸方向に対して交互に周期的に配置され、さらに凹凸部の平均周期λが、０＜λ≦５００μｍであり、隣接する凹凸部の平均波高値ｈが、０＜ｈ≦５μｍである薄帯製造装置。



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【特許請求の範囲】

【請求項１】帯状薄帯の少なくとも片側の表面に、薄帯の長手方向に対して平行に長さ１００μｍ以上の連続した凹部あるいは凸部を有し、それらの凹部あるいは凸部が該薄帯の幅方向に対して交互に周期的に配置され、該凹凸部の領域が少なくとも片側の表面において７０％以上占めることを特徴とする急冷金属薄帯。

【請求項２】薄帯の長手方向に対して平行に長さ１㎜以上の連続した凹部あるいは凸部を有している請求項１に記載の急冷金属薄帯。

【請求項３】合金を溶融する装置、溶融合金をノズルから噴出する装置、噴出した溶融合金を冷却するための高速回転する冷却基板、および該冷却基板を研磨する装置を有する急冷金属薄帯の製造装置において、冷却基板の溶湯と接触する面が、冷却基板の回転方向に長さ１００μｍ以上の一本の連続した凹部あるいは凸部を有し、かつ、それらが回転軸方向に対して交互に周期的に配置されていることを特徴とする急冷金属薄帯製造装置。

【請求項４】冷却基板回転軸方向の凹凸部の平均周期λが、０＜λ≦５００μｍであり、隣接する凹凸部の平均波高値ｈが、０＜ｈ≦５μｍである請求項３に記載の急冷金属薄帯製造装置。

【請求項５】冷却基板の回転方向に長さ１㎜以上の一本の連続した凹部あるいは凸部を有している請求項３および４に記載の急冷金属薄帯製造装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、溶融状態の合金を高速回転している冷却基板に噴出して急冷凝固した金属薄帯、およびその製造装置に関する。

【０００２】

【従来の技術】合金を溶融状態から急冷することによって、連続的に薄帯を製造する方法としては、遠心急冷法、単ロール法、双ロール法、等が知られている。これらの方法は、高速回転する金属製ドラムの内周面または外周面に溶融金属をオリフィス等から噴出させることによって、急速に溶融金属を凝固させて薄帯や線材を製造するものである。さらに、合金組成を適正に選ぶことによって、液体金属に類似した非晶質合金を得ることができ、磁気的性質、あるいは、機械的性質に優れた材料を製造することができる。

【０００３】これらの非晶質合金薄帯は、冷却基板に接触して、それによる急速抜熱によって凝固する。したがって、薄帯の表面形状は冷却基板の表面形状に大きく左右され、この薄帯の表面形状が粗くなると磁気特性が劣化するのみならず、トランス等のコア材としてコイルあるいは積層体にした場合に占積率が低下する等の問題が生じる。そこで、従来から、ロール表面粗度を規定することによって薄帯の表面形状を改善する手法が開発されている。

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【０００４】例えば、表面がバフ研磨によってミクロンオーダー以下の凹凸にした冷却体（特開昭６２－１６６０５９号公報）、冷却ロール表面を砥粒ナンバー６００～１０００番の研磨紙で研磨して得られる粗さにする方法（特開平４－２８８９５２号公報）、接触面を梨地面にした冷却体（特開昭５６－１１７８６８号公報）、冷却ロール表面に回転方向に対して斜めにスクラッチがある冷却体およびそれによって製造した薄帯（特開昭６０－７２６４８号公報）、ロール表面にある凹凸部の溝の方向がロール軸方向に平行である装置およびその装置で製造された薄帯（特開昭５８－１４９１７号公報）、等がある。

【０００５】しかし、単ロール法等で製造した急冷薄帯のロール面側には、通常、ロール表面の凹凸以外にエアーポケットと呼ばれるガスの巻込みによって生じる島状の比較的大きな凹部が存在する。このエアーポケットは磁気特性を劣化させるのみならず占積率も低下させるが、上記した公知例にはいずれもこのエアーポケットに関する記載はない。さらに、薄帯表面および冷却体表面の粗度の規定に関しても、凹凸部の粗さのみの規定であり、エアーポケットを低減できるようなものではない。

【０００６】また、特開昭６２－１６６０５９号公報、および特開平４－２８８９５２号公報では、砥粒研磨紙などを用いて規定された冷却体の表面粗度に仕上げているため、冷却体表面の凹凸部の溝は冷却体の回転方向に一応は伸びているが、エアポケットを低減できるまでには至っていない。特開昭５６－１１７８６８号公報、特開昭６０－７２６４８号公報、および特開昭５８－１４９１７号公報では、冷却体表面の凹凸部の溝は冷却体の回転方向に対して傾斜しているかあるいは直角になっている。

【０００７】

【発明が解決しようとする課題】以上に示した如く、冷却体の表面形状を規定することによって薄帯の特性向上が試みられてはいるが、薄帯の冷却体に接触する面にエアーポケットができるのを抑制できる製造装置、およびそれによって製造した急冷金属薄帯は従来にはなかった。

【０００８】本発明は、冷却体の表面形状を改善することによって、エアポケットの低減した磁気特性および占積率に優れた急冷金属薄帯、およびその製造装置を提供することを目的とする。

【０００９】

【課題を解決するための手段】本発明は、下記の事項をその要旨としている。

（１）　帯状薄帯の少なくとも片側の表面に、薄帯の長手方向に対して平行に長さ１００μｍ以上の連続した凹部あるいは凸部を有し、それらの凹部と凸部が該薄帯の幅方向に対して交互に周期的に配置され、該凹凸部の領

とを特徴とする急冷金属薄帯。

（２）　薄帯の長手方向に対して平行に長さ１㎜以上の連続した凹部あるいは凸部を有している前項（１）に記載の急冷金属薄帯。

（３）　合金を溶融する装置、溶融合金をノズルから噴出する装置、噴出した溶融合金を冷却するための高速回転する冷却基板、および該冷却基板を研磨する装置を有する急冷金属薄帯の製造装置において、冷却基板の溶湯と接する面が、冷却基板の回転方向に長さ１００μｍ以上の一本の連続した凹部あるいは凸部を有し、かつ、それらが回転軸方向に対して交互に周期的に配置されていることを特徴とする急冷金属薄帯製造装置。

（４）　冷却基板回転軸方向の凹凸部の平均周期λが、０＜λ≦５００μｍであり、隣接する凹凸部の平均波高値ｈが、０＜ｈ≦５μｍである前項（３）に記載の急冷金属薄帯製造装置。

（５）　冷却基板の回転方向に長さ１㎜以上の一本の連続した凹部あるいは凸部を有している前項（３）および（４）に記載の急冷金属薄帯製造装置。

【００１０】以下に、本発明を詳細に説明する。図１には、従来例として、通常の砥粒研磨紙で研磨した場合の冷却基板表面の断面拡大図を示した。図１から分るように、凹部あるいは凸部が整然と所定の長さだけ並んでいる部分は僅かであり、ほとんどの部分は凹部あるいは凸部同士が互いに交差して切り合っており、溝が途中で切れた状態になっている。したがって、鋳造中にパドルの上流側から冷却基板と溶湯の間に巻込まれたガスは、溶湯の圧力によって上流側に押し戻されるが、溝が途中で切れているために移動できなくなってしまう。そのため、ガスの一部を巻込んだ状態で凝固してしまい、それがエアーポケットとして薄帯に現れる。このエアーポケットは、鋳造条件にもよるが、大きいもので幅約２０μｍ、長さ約２００μｍにも達する。

【００１１】本発明者らは、種々の検討を重ねた結果、従来採用されていた冷却基板の粗度のみならず凹部あるいは凸部の冷却基板回転方向の長さを新たに規定することによって、エアーポケットの発生を低減できることを見い出した。

【００１２】本発明による冷却基板の一例である表面の断面拡大図を、図２に示す。冷却基板の回転方向に長さ１００μｍ以上の一本の連続した凹部あるいは凸部を有し、かつ、それらが回転軸方向に対して交互に周期的に配置している。図２では、凹凸断面が三角波的である場合を示したが、正弦波的、あいるは、矩形波的等の他の形状も本発明範囲に含まれる。すなわち、冷却基板の回転方向の長さが１００μｍ以上である凹部あるいは凸部を回転軸方向に交互に周期的に配置した領域を設けることによって、一度巻込まれたガスが１００μｍ以上の長さに整然と並んでいる溝を通って溶湯が凝固する前に押し出される結果、エアーポケットが低減すると考えられる。

【００１３】エアーポケットをさらに低減させるには凹部あるいは凸部の冷却基板回転方向の長さを１㎜以上にする。加工の容易性を考慮すると、この長さを５㎜以上にすることが好ましい。このような領域を冷却基板の全周に渡って設けることによって、全長に渡ってエアーポケットが低減した薄帯が得られる。

【００１４】冷却基板の凹凸部の平均周期λ、あるいは、隣接する平均波高値ｈも冷却された薄帯表面の形状を左右する。λ＝０、ｈ＝０は、鏡面状態であり、この状態では冷却基板と溶湯との濡れ性が悪くなって、健全な薄帯を得ることができなかった。λ＞５００μｍでは、溝の数が少なくなるために巻込まれたガスが押し出される効果が減少する。また、ｈ＞５μｍでは、エアーポケットは抑制されるが、冷却された薄帯の凹凸が大きくなって表面形状が悪くなってしまう。したがって、０＜λ≦５００μｍ、０＜ｈ≦５μｍに限定した。

【００１５】本発明の冷却基板表面は、規則的に砥粒を並べた研磨紙を用いるか、あるいは所定の形状に加工した超鋼等の工具鋼を用いて容易に形成できる。用いる材質としては、超鋼のみならず冷却基板よりも硬度が大きいものであれば使用可能である。また、図３に示したように、オンラインで研磨しながら所定の表面状態を維持することも可能である。ただし、図３は、急冷薄帯製造装置の概略図であり、合金を溶融する装置、溶融合金をノズルから噴出する装置、噴出した溶融合金を冷却するための高速回転する冷却基板、冷却基板を研磨する装置から構成される。

【００１６】上記した製造装置で冷却された薄帯は、エアーポケットが低減されており、帯状薄帯の少なくとも冷却基板側の表面に、薄帯の長手方向に対して平行に長さ１００μｍ以上の連続した凹部あるいは凸部が該薄帯の幅方向に対して交互に周期的に配置し、かつ、該凹凸部が少なくとも片側の表面において７０％以上占めるようになる。言い変えれば、エアーポケットが少なくとも片側の表面において３０％より少なくなる。占積率の点から見れば、該凹凸部が少なくとも片側の表面において８０％以上占めるようになることが好ましい。さらに、冷却基板の凹部あるいは凸部の回転方向長さを１㎜以上にすることによって、エアーポケットがさらに低減し、薄帯の長手方向に対して平行に長さ１㎜以上の連続した凹部あるいは凸部を有した薄帯が得られる。

【００１７】本発明の冷却基板で冷却した薄帯の冷却基板側表面の凹凸部の周期は、通常、基板の凹凸部の影響を受けて、５００μｍ以下となり、隣接する凹凸部の平均波高値は、５μｍ以下となる。薄帯の板厚は、公知である単スリットノズル、あるいは多重スリットノズルを用いて１０～１００μｍを越えるものまで製造可能である。板厚が薄い場合には、冷却基板の凹凸は、薄帯の自由面側（冷却基板と接する面と反対側の面）にも影響

し、冷却基板の凹凸に応じた凹凸が現れる。多重スリットノズルを用いて厚い薄帯を製造する場合には、冷却基板の凹凸は、薄帯の自由面側には影響しにくくなる傾向にある。

【００１８】

【実施例】以下、本発明を実施例に基づいてさらに説明する。

実施例１

$Fe_{80.5}Si_{6.5}B_{12}C_1$（ａｔ％）の合金を溶解し、２重スロットノズル（幅＝０．４㎜、長さ＝２５㎜、間隔＝１㎜）から７００rpm で回転している直径５８０㎜のＣｕ製ロールの上に溶湯を噴射して、幅２５㎜、厚み６０μｍの急冷薄帯を作製した。

【００１９】この際、Ｃｕロール表面を下記の方法で所定の凹凸に加工した。すなわち、先ず、通常のエメリ紙による研磨とバフ研磨によって、ロール表面を鏡面に仕上げる。次に、予め工具鋼に凹凸を付けた治具を用いて、治具を押し当てながらロールを回転させてロール表面に所定の大きさの凹凸を付けた。その際、回転距離を変えることによって凹凸部の回転方向に連続している長さを調節した。結果的には、凹凸のロール軸方向の断面形状は三角波的なものになり、凹凸部の平均周期は約４０μｍ、隣接する凹凸部の平均波高値は約０．８μｍとなった。

【００２０】ロール表面の凹凸部の測定は、レプリカ法でロールの凹凸を樹脂に転写して、その樹脂を粗度計で測ることによって行った。薄帯の表面形状は、粗度計による評価と光学顕微鏡で撮影した写真から求めたロール面側薄帯表面のエアーポケットの割合で評価した。薄帯表面のエアーポケット以外の部分は全て、ロール表面の凹凸部の長さとほぼ同じ長さの薄帯長手方向に連続した凹凸部があり、かつ、それらが幅方向に対して交互に周期的に配置していた。その測定結果を、表１に示す。

【００２１】

【表１】

表　１

試料No.		凹凸部のロール回転方向長さ（連続している部分の長さ）	薄帯表面のｴｱｰﾎﾟｹｯﾄ率(%)（ロール面側）
比較例	1	30μm	35
	2	70μm	33
本発明例	3	120μm	26
	4	450μm	25
	5	730μm	23
	6	1．2㎜	18
	7	3．0㎜	16
	8	20㎜	13
	9	100㎜	13
	10	ロール周囲の1/2 長さ	11
	11	ロール全周長さ	12

【００２２】表１から分るように、本発明にしたがって、凹凸部のロール回転方向の長さを１００μｍ以上にすることによって、エアーポケットの割合を３０％より低く抑えた薄帯を得ることが可能になる。さらに、その長さを１㎜以上にすることによって、エアーポケットの割合を２０％以下に抑制した薄帯を得ることができる。

【００２３】実施例２

種々の大きさの凹凸を付けた治具を用いて、表２に示した凹凸をロール表面に加工した。凹凸のロール回転方向に連続した長さをロール周囲の１／２長さと一定にした以外は、実施例１と同様に行った。ただし、λは凹凸部の平均周期、ｈは隣接する凹凸部の平均波高値である。薄帯表面のエアーポケット以外の部分は全て、ロール表面の凹凸部の長さとほぼ同じ長さの薄帯長手方向に連続した凹凸部があり、かつ、それらが幅方向に対して交互に周期的に配置していた。その結果を、表２に併記する。

【００２４】

【表２】

表　２

試料No.	凹凸部の平均周期 λ（μm）	隣接する凹凸部の平均波高値 h（μm）	薄帯表面のｴｱｰﾎﾟｹｯﾄ率(%)（ロール面側）
12（比較例）	0	0	不良薄帯となった
13（本発明例）	12	0．8	13
14　〃	40	0．9	11
15　〃	105	0．9	14
16　〃	255	1．2	16
17　〃	360	1．5	21
18　〃	480	1．4	24
19（比較例）	580	1．3	32
20　〃	720	1．2	34
21（本発明例）	35	1．3	12
22　〃	50	2．5	15
23　〃	68	3．8	21
24（比較例）	72	5．2	23（表面凹凸大）
25　〃	82	6．5	27（表面凹凸大）

【００２５】表２から分るように、本発明にしたがって、０＜λ≦５００μｍ、０＜ｈ≦５μｍにすることによってエアーポケットの割合を３０％より低く抑えた薄帯を製造することができる。ただし、表２の試料Ｎｏ．２４と２５では、エアーポケットの割合は３０％より低くなっているが、表面の凹凸が大きくなって表面形状が悪くなったため、本発明の範囲外とした。

【００２６】

【発明の効果】本発明に従って、表面形状を規定した冷却基板を用いて薄帯を製造することによって、薄帯表面の粗度を改善し、エアーポケットの発生を低減した薄帯を得ることができる。このようにして得られた薄帯は、トランス等の用途として、巻きコアあるいは積層コアにした場合、占積率が向上するばかりでなく、磁気特性も改善される。

【図面の簡単な説明】

【図１】従来の冷却基板の一例である表面の形状を示した断面拡大図である。

【図２】本発明による冷却基板の一例である表面の形状を示した断面拡大図である。

【図３】急冷薄帯製造装置の概略図である。

【符号の説明】

λ　凹凸部の平均周期

h　隣接する凹凸部の平均波高値

1　高周波コイル

2　ノズル

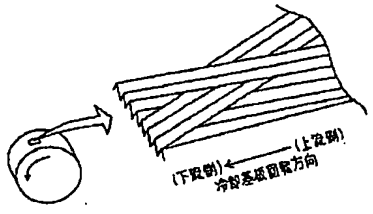
3　溶湯

4　薄帯

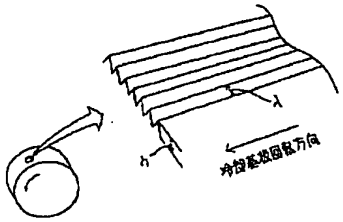
5　冷却ロール

6　研磨器

【図１】



【図２】



【図３】